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(54) CAPILLARY PUMP LOOP

[Amendment has been incorporated in the translation]

TITLE OF INVENTION

Capillary Pump Loop

CLAIM

Capillary pump loop, characterized in that the capillary pump loop comprises evaporators wherein an operating fluid is brought in from an operating fluid inlet, followed by heating to make it evaporate so that the vapor is let out from a vapor outlet; a condenser wherein the vapor of said operating fluid is brought in from the vapor outlet to be cooled and condensed, and the operating fluid condensed is let out from the operating fluid outlet; a vapor flow channel that connects said vapor outlet of said evaporator to said vapor inlet of said condenser; and an operating fluid flow channel that connects said operating fluid outlet of said condenser to said operating fluid inlet of said evaporator; with check valves being installed at said vapor outlet of said evaporator as well as at said vapor inlet of said condenser in the direction preventing backflow of the vapor.

DETAILED DESCRIPTION OF THE INVENTION

Field of Industrial Application

The present invention pertains to the improvement of a capillary pump loop used as temperature control device.

Prior Arts, and its Problems

The conventional capillary pump loop is configured as seen in Figure 2. Operating fluid 5 enters evaporators 2a, 2b to be heated and vaporized from wicks 3a and 3b. Vapor 4 goes to condenser 8 passing through vapor flow channel 9 to release its heat and undergoes condensation, and it returns to liquid. Operating fluid 5, which has returned to liquid, goes back to evaporators 2a and 2b through liquid flow channel 10. Endothermic efficiency of the evaporator will decrease if vapor became mixed in the operating fluid 5 that entered the evaporators 2a and 2b. A vapor-liquid separation function is provided to the reservoir 6, which is the tank for operating liquid 5. The pressure inside the capillary pump loop will be maintained at constant level and the saturated temperature will be controlled at constant level even if there is variation in heat generation as well as condensation capability. Following such circulation of the operating fluid 5 and its vapor 4, the heat is absorbed at evaporators 2a and 2b to vapor 4, and transferred to condenser 8 to be released here. Liquid freon or liquid ammonia that has large latent heat of vaporization is used as the operating fluid in order to create a large absorption of heat as well as heat generation. In this way, heat is absorbed at evaporators 2a and 2b, and

released at condenser 8, so the heat can be released from inside the apparatus to the outside if the evaporator is housed inside the apparatus and the condenser is installed outside. On the contrary, installing the condenser inside the apparatus, and the evaporator outside, can capture the heat from outside into the inside of the apparatus. As can be seen in Figure 2, using the capillary pump built using several evaporators to release the heat at the apparatus generates temperature differences among evaporators according to the differences in the amount of heat generation of the apparatus present surrounding each evaporator. Depending on its temperature differences, the generation amount of vapor among the evaporators as well as the balance of the vapor pressure will be lost, and the vapor will flow from the evaporator with high pressure to the evaporator with low pressure. When the vapor back-flows, depending on its evaporator, the process of evaporating the operating fluid and absorbing the heat will deviate from the normal condition, and it can no longer be controlled. Moreover, when this capillary pump is used as the temperature control device of a satellite, the operating fluid 5 may invade from the vapor inlet of condenser 8 to the vapor flow channel 9 due to the influence of vibration or impact of the launch. This will generate vacuum bubbles from the bulk portion of the operating fluid 5 that was leaking at the vapor flow channel 9 in the operating fluid 5 at evaporator 2a and 2b, fluid flow channel 10, and condenser 8, and it will disperse in the liquid. These bubbles are equivalent to the silver leakage [sic, possibly referring to mercury leakage] of a mercury thermometer; however, if this type of symptom occurs, the circulation of the operating liquid in the evaporator will be discontinued, making the capillary pump unable to start.

The purpose of the present invention is to provide a capillary pump loop that does not have shortcomings mentioned above.

Means to solve the problems

The capillary pump loop of the present invention is characterized in that, as shown in Figure 1, the capillary pump loop comprises evaporators wherein an operating fluid is brought in from an operating fluid inlet, followed by heating to make it evaporate so that the vapor is let out from a vapor outlet; a condenser wherein the vapor of said operating fluid is brought in from the vapor outlet to be cooled and condensed, and the operating fluid condensed is let out from the operating fluid outlet; a vapor flow channel that connects said vapor outlet of said evaporator to said vapor inlet of said condenser; and an operating fluid flow channel that connects said operating fluid outlet of said condenser to said operating fluid inlet of said evaporator; with check valves being installed at said vapor outlet of said evaporator as well as at said vapor inlet of said condenser in the direction preventing backflow of the vapor.

Application Example

Figure 1 shows an application example of a capillary pump loop of the present invention. Check valves 1a, 1b, and 1c are provided at the vapor outlets of each evaporators 2a and 2b as well as at the vapor flow channel 9 of the vapor inlet of condenser 8. These check valves are installed in the direction preventing the backflow of the vapor as shown with the arrow in the

figure. In this way, operating fluid 5 and its vapor 4 are circulated in the forward direction so that it will not backflow under any circumstances.

Effect of the Invention

In this way, the capillary pump loop of the present invention does not incur a defect where it cannot be controlled because backflow of the vapor will not occur even when the imbalance of vapor pressure occurred among several evaporators. In addition, it will not fail to start because it will not generate bubbles in the operating fluid because the operating fluid does not leak into the vapor phase when it is installed in the satellite.

BRIEF EXPLANATION OF THE FIGURE

Figure 1 is an outline drawing showing the configuration of the application example of the present invention, and Figure 2 is an outline drawing showing the configuration of the conventional capillary pump loop.

1a, 1b, 1c … check valves, 2a, 2b … evaporators, 3a, 3b … wicks, 4 … vapor, 5 … operating fluid, 6 .. reservoir, 7 … separated vapor, 8 … condenser, 9 … vapor flow channel, 10 … fluid flow channel.

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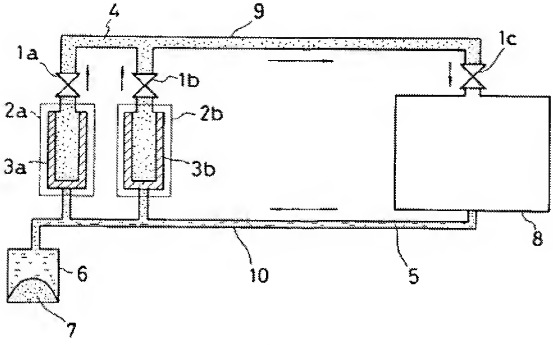

Figure 1

1a, 1b, 1c ... check valves, 2a, 2b ... evaporators, 3a, 3b ... wicks, 4 ... vapor, 5 ... operating fluid, 6 .. reservoir, 7 ... separated vapor, 8 ... condenser, 9 ... vapor flow channel, 10 ... fluid flow channel.

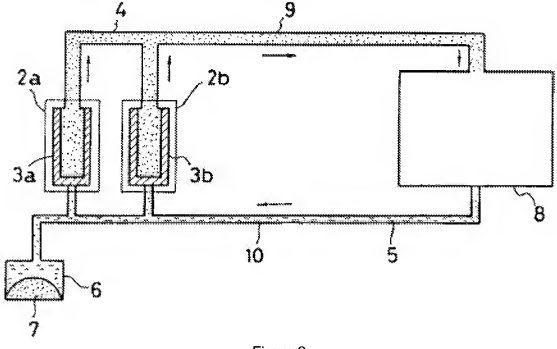

Figure 2

1a, 1b, 1c ... check valves, 2a, 2b ... evaporators, 3a, 3b ... wicks, 4 ... vapor, 5 ... operating fluid, 6 .. reservoir, 7 ... separated vapor, 8 ... condenser, 9 ... vapor flow channel, 10 ... fluid flow channel.